C.D. Howe Institute
Commentary

[illegible] 2000 ISSN 0824-8001

Stop the Press!

Rapid Money Growth May Bring Higher Inflation

William B.P. Robson
Shay Aba

In this issue...

The stock of transactions money in Canada — the monetary aggregate M1 — is growing so fast that the Bank of Canada may need to raise interest rates to prevent rising inflation.

The Study in Brief...

Recent growth of M1, a measure of money in Canada closely associated with spending, has been extraordinarily rapid: 24 percent over the year to July. Past periods of such explosive monetary expansion have signalled unsustainable growth in spending and rising inflation. M1's past record as a leading indicator, and its role in the chain that links Bank of Canada policy with economic growth and inflation, raises the question of whether the Bank needs to tighten policy to avoid an inflationary blow-off.

If M1 is expanding in line with the money demand of households and firms whose output and spending are growing at a pace consistent with the Bank of Canada's 2 percent inflation target, there is no reason for alarm. If, however, the growth of M1 is outpacing that demand, Canada could be headed for trouble.

To determine whether the country's demand for money is growing fast enough to absorb the rising stock of M1 without higher inflation, the study first adjusts the Bank of Canada's M1 aggregate by removing distortions caused by innovations and ownership changes in the banking system. Statistical techniques are then applied to estimate how changes in spending and interest rates may have affected the demand for transactions money.

Using as a benchmark the fourth quarter of 1997 — a time when the economy was doing reasonably well (though operating somewhat below its productive capacity) and when monetary growth seemed conducive to stable inflation — the study compares the growth of the money supply since then to high and low estimates of growth in money demand. Despite several assumptions that lead to a generous assessment of the possible rate of demand growth, the study finds that recent demand is unlikely to have grown fast enough to absorb the current money stock without inflation.

It appears that, if the growth of M1 does not soon fall below double digits, the Bank of Canada will have to raise short-term interest rates to protect the country from rising inflation.

The Authors of This Issue

William B.P. Robson is Director of Research at the C.D. Howe Institute. He specializes in Canadian fiscal and monetary policy. His 1994 book, *The Great Canadian Disinflation*, co-authored with David Laidler, won the Canadian Economics Association's Doug Purvis Memorial Award for excellence in writing on Canadian economic policy.

Shay Aba is a Research Analyst at the C.D. Howe Institute. He has a degree in economics from York University.

C.D. Howe Institute Commentary© is a periodic analysis of, and commentary on, current public policy issues. The manuscript was copy edited by Lenore d'Anjou and prepared for publication by Wendy Longsworth and Barry A. Norris. As with all Institute publications, the views expressed here are those of the author, and do not necessarily reflect the opinions of the Institute's members or Board of Directors.

To order this publication, please contact: Renouf Publishing Co. Ltd., 5369 Canotek Rd., Unit 1, Ottawa K1J 9J3 (tel.: 613-745-2665; fax: 613-745-7660), Renouf's stores at 71½ Sparks St., Ottawa (tel.: 613-238-8985) and 12 Adelaide St. W., Toronto (tel.: 416-363-3171), or the C.D. Howe Institute, 125 Adelaide St. E., Toronto M5C 1L7 (tel.: 416-865-1904; fax: 416-865-1866; e-mail: cdhowe@cdhowe.org).

$10.00; ISBN 0-88806-476-4

After disappointing growth during most of the 1990s, the Canadian economy entered the new decade with a bang. Output and jobs are expanding healthily. Through the first half of 2000, real gross domestic product (GDP) was up about 5 percent from year-earlier levels, while job growth of about 3 percent reduced the unemployment rate to around 7 percent. Meanwhile, inflation remains under control. Despite a one-time push from higher oil prices that raised the total consumer price index (CPI) 3 percent above its year-earlier level in June, core measures of inflation remain around 1.5 percent, below the Bank of Canada's target of 2 percent and well within the 1-to-3 percent band around the target. On its face, then, Canada's economic performance seems to be just about everything that the makers of monetary policy could wish for.

Past experience shows, however, that maintaining steady growth with stable inflation is no easy task. Modern economies are complex, and signals of future growth and potential inflation are rarely straightforward. In Canada, fortunately, one indicator of financial conditions has proved over many years to provide useful advance information about the economy. That indicator is M1, which is usefully thought of as *transactions money* because it is essentially the aggregate of cash held outside the banking system and demand deposits (chequing accounts) at the chartered banks, the forms of money most commonly used in spending on goods and services. And M1 is now growing extraordinarily rapidly: it was up almost 24 percent over the year to July, and recent monthly growth rates show no slackening. To use an archaic but effective image, the money-printing press is running full bore.

Such explosive growth of M1 is rare. Among the few past periods of comparable expansion are episodes in the early 1970s and late 1980s, when rapid M1 growth preceded unsustainable expansions of spending and rising inflation. It is natural to wonder, therefore, whether recent M1 growth signals that the 125 basis point increase that the Bank of Canada has engineered in the Bank rate since late 1999 is insufficient. Does the Bank need to slow the press further and nip an inflationary blowoff in the bud?

Making Sense of M1 Growth

Answering that question requires an estimate of how much M1 is too much. If the stock of M1 is expanding in line with the requirements of households and firms whose output and spending are growing at a pace consistent with stable inflation, there is no reason for alarm. If, on the other hand, the current stock of M1 in the economy is above that amount or if recent growth rates would soon push it above that amount, then the Bank of Canada needs to act to prevent inflation from rising.

How much money do households and firms need to support stable-inflation rates of growth? As often in economics, clues to this question can be found in past relationships. Particularly important are the growth of the economy's productive potential and the level of interest rates on other financial assets (because these interest rates determine the cost that holders of money incur by passing up investments in higher-yielding alternatives). Since M1 as conventionally measured is also influenced by innovations in the banking industry, however, using past data to estimate the

We thank David Laidler, Loretta Nott, and several other referees for comments. Responsibility for the conclusions presented here and for any remaining errors is ours.

demand for money requires considerable care and some adjustments, which we describe below.

Stop the Press!

To preview our conclusions, our review of past relationships suggests that, while the Canadian economy's demand for transactions money is likely expanding robustly, it is not growing strongly enough to absorb as much transactions money as is now being created. Even after we make generous allowances for the uncertainties that always arise in using past evidence to predict the future, it looks as though the press is running too fast, threatening a pickup in inflation.

Our concerns on this score are all the greater because our statistical work on the response of money demand to growth in output — and hence the rate at which money can grow without boosting inflation — yields estimates that are higher than theoretical and empirical work usually produce. If we have overestimated the response of money demand to output growth, we have probably underestimated the amount of excess M1 currently in circulation. There is always a possibility that developments in the financial sector beyond those we have taken into account are producing misleading signals. But our concern is supported by other evidence: growth in broader monetary aggregates that is faster than the Bank of Canada has estimated as consistent with stable inflation in the past; the persistent weakness of the exchange rate, which suggests an oversupply of Canadian dollars; and last but not least the fact that consumer price inflation is already at the top of the Bank's 1-to-3 percent band.

On the whole, it seems that the Bank may need to raise short-term interest rates further, slowing the press, to get inflation back to its 2 percent target.

Why Worry about M1?

M1 is not the only measure of the quantity of money in the country. For many purposes, broader aggregates are useful (see Box 1). But M1 warrants special attention.

M1 has a long-standing record as a signal of future economic growth and inflation.

The simplest argument for watching M1 and for reacting to overrapid growth by raising short-term interest rates is that this monetary aggregate has a long-standing record as a signal of future economic growth and inflation. There are reasons to think that this record is not just a coincidence or an artifact of the data, but that it reflects an important role for money in transmitting the central bank's actions to the broader economy.

M1's Forecasting Record

To begin with, M1's record as a predictor of growth is as good as or better than that of any other leading indicator. Figure 1 illustrates the year-over-year growth of M1 and of GDP (both adjusted for inflation) since the late 1960s. Even this simple representation — which neglects the fact that changes in interest rates can affect growth of money demand, causing occasional changes in the relationship between M1 growth and the economy — illustrates M1's solid forecasting record. Instances in which the aggregate provided misleading signals of economic accelerations and decelerations are

Box 1: *Canadian Monetary Aggregates*

Counting the quantity of money in an economy is a challenging exercise because it is often difficult to know what to include. Because the possibilities are so numerous, most countries have several definitions. Those used in Canada, from the narrowest to the broadest, include

- *currency outside banks*: the notes and coins issued by the Bank of Canada and the Royal Canadian Mint that are outside the banking system;
- *M1*: currency outside banks plus Canadian-dollar demand deposits (chequing accounts) at Canadian banks net of the private sector float (a balancing amount related to transactions that are not yet complete);
- *M2*: M1 plus the chartered banks' holdings of personal saving deposits (these may have chequable features) and nonpersonal (firms') notice deposits;
- *M2+*: M2 plus personal and nonpersonal deposits at the near banks (trust companies, credit unions, caisses populaires, and so on) plus funds invested in certain money market mutual funds; and
- *M2++*: M2 plus Canada Savings Bonds and non-money market mutual funds.

Source: Adapted and updated from Laidler and Robson 1994, 54.

comparatively rare, and this reliability is reflected in its tendency to lead major rises and falls of inflation as well.

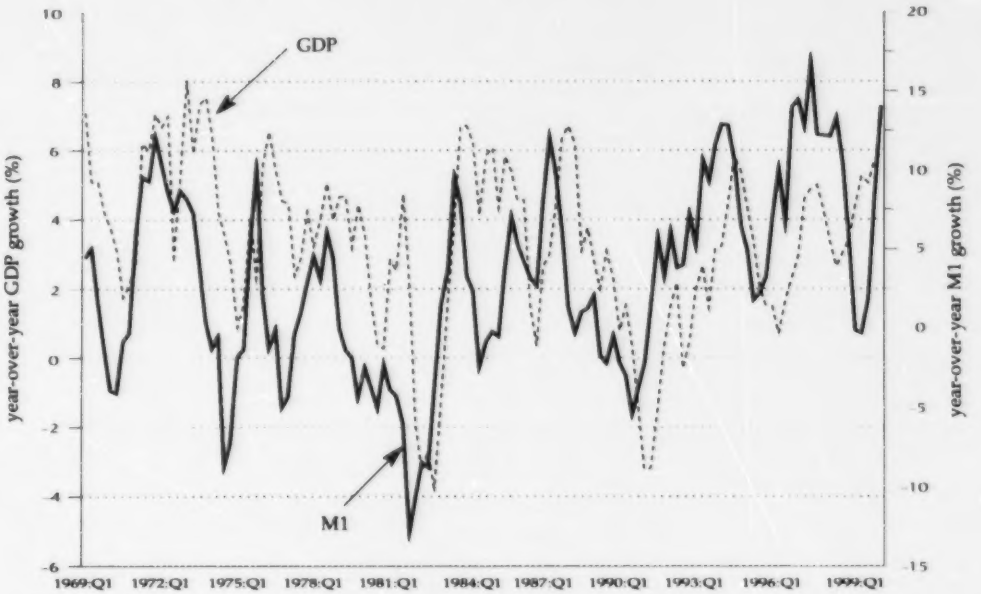
M1's Role in Transmitting Monetary Impulses to the Economy

If M1's tendency to lead economic growth and inflation was simply an observed fact without any apparent explanation, it would be wise to be skeptical about its reliability as a signal of future economic developments. However, there are good reasons to think that this tendency is not a coincidence of timing — say, with movements in M1 being observed just ahead of the economic fluctuations they accompany — but rather that it reflects an important role for transactions money in the economy.

Unlike broader measures of money that include accounts at financial institutions containing instruments used as stores of wealth, M1 is money that households and businesses use when they buy and sell goods and services.[1] And as M1 is passed from hand to hand, it conveys important information to its recipients about the state of the

1 This focus on M1's role in transactions is why we prefer to use net M1, as shown in Figure 1. This aggregate adjusts the total of currency and chequing accounts for payment items in transit — in "float" — which consist mainly of cheques that have been credited against the payee's account but not yet deducted from the payer's account (and thus must be subtracted to avoid double counting) and bank drafts that have been deducted from the payer's account but not yet credited to the payee's account (which must be added). Float can vary dramatically from month to month. This volatility, along with uncertainty about whether all the items in float are moving between accounts measured in M1, has made the Bank of Canada wary of net M1; recent Bank commentary has focused on its gross counterpart. Float's obviously transactions-oriented nature, however, makes it hard to ignore in an "active money" view of the world — a theoretical consideration that gains additional force from the empirical observation that net M1 is a slightly better leading indicator of GDP than is gross M1.

Figure 1: ***Real Growth Rates of GDP and M1, 1969:Q1–2000:Q2***



Note: The aggregate reported here is measured M1 net of items in transit. See the text for an explanation of the difference between gross and net M1 and our reasons for using the latter here.

Sources: Statistics Canada, CANSIM; and authors' calculations.

economy generally and about their own financial condition and prospects particularly.[2] This information, in turn, alters their spending decisions. When money receipts are higher than expected, households and businesses gain confidence and raise their consumption and investment; when money receipts are lower than expected, they lose confidence and lower spending.

As spending rises and falls, the rate at which the economy is absorbing goods and services rises and falls as well, intensifying or easing pressure on its productive capacity. Money growth that promotes absorption in line with capacity tends to yield stable inflation, as seems to have been the case for the past few years. Money growth rapid enough to push absorption above the economy's productive capacity tends to push inflation higher, with buyers becoming more numerous and more eager than sellers, as happened in Canada during the early 1970s and the late 1980s. And money growth that chokes off spending, creating a gap between output and capacity, lowers inflation, as happened in the early 1980s and again in the early 1990s.

During times when economic growth and inflation are stable, financial markets are calm, and monetary policy is steady, M1 receipts and balances tend to coincide with household and business expectations, and the rate of M1 growth yields little or no

2 In contrast is a "passive money" view, in which portfolio readjustments keep the amount of money actually available in the economy equal to the amount of money demanded. In this view, neither M1 nor any other measure of the money stock has causative power. The passive money view seems more apt for the saving accounts included in M2 and M3, which more closely resemble other financial assets such as money-market securities, than for M1, which is far likelier to be exchanged against goods and services.

information about the future beyond what other indicators of expectations, spending, and output provide. At other times, however, the stock of M1 may differ from what households and businesses would demand in equilibrium. On those occasions, M1 may provide signals that are useful to the Bank of Canada as it seeks to keep inflation from dropping below the bottom or rising through the top of its target band.

How Much M1 Does Canada Need?

To decide whether recent M1 growth signals inflationary pressure, we need to do two things.

First, recalling that M1 occasionally has provided misleading signals in the past, apparently because of innovations in the banking industry and the financial environment more generally, we need to allow for the possibility that similar extraordinary factors are affecting M1 growth in the present.

Second, after allowing for any such factors, we need to estimate how much M1 Canadian households and businesses would wish to hold if the economy were growing at a rate consistent with steady inflation, and if other influences on the demand for M1 — in particular, the cost of holding it rather than other financial assets that pay higher rates of interest — were at levels consistent with that growth. If current growth is driving M1 to a level that exceeds our estimates of the demand for it, the Bank probably needs to act to rein it in.

Institutional Factors Influencing M1

Getting a picture of the growth of transactions money clear enough to make inferences about future economic activity and inflation may require adding or deleting certain types of accounts from the published aggregate.

From time to time, technological innovations and structural changes in the banking industry make M1 a misleading measure of transactions money. Under those circumstances, getting a picture of the growth of transactions money clear enough to make inferences about future economic activity and inflation may require adding or deleting certain types of accounts from the published aggregate.[3]

One much-examined example of an innovation that affected M1 occurred in the late 1970s and early 1980s, when banks introduced daily interest and savings accounts as well as cash-management packages for businesses. By providing a convenient, higher-yielding alternative to largely interest-free demand deposits, these innovations effectively raised the opportunity cost of holding M1, lowering its growth rate over a protracted period of time.[4]

More recently, two financial industry developments appear to be affecting the stock of M1 in the other direction. First, the chartered banks' absorption of major investment dealers has led to the inclusion in M1 of free credit balances — cash balances that investors keep with their brokers. These balances are as liquid as chequing accounts, but their creation and destruction reflect portfolio adjustments, rather than transactions in goods and services. There is therefore no reason to expect M1 movements that reflect

3 For a recent survey of alternative measures of transactions money, see Aubry and Nott (2000).

4 By 1986, Aubry and Nott (2000, 2) estimate that the cumulative effect of these innovations left the stock of M1 30 percent lower than it otherwise would have been. As we explain below, we deal with this change in opportunity cost by including an appropriate measure of opportunity cost in our regressions.

changes in free credit balances to signal future changes in output and prices in the same way that movements reflecting changes in other components of the aggregate do. In addition, part of the recent growth of M1 reflects increases in deposits held at banks by nonbank financial institutions. These accounts also are unlikely to reflect transactions in goods and services.[5] Accordingly, we subtract from M1 both free credit balances and the deposits of other financial institutions, producing an aggregate we call *adjusted M1* (M1A).

Another complication in interpreting M1 arises from a development in the early 1990s: the removal of the requirement that banks hold non-interest-bearing reserves with the Bank of Canada against demand deposits.[6] When the reserve requirement disappeared, flows of money out of nonpersonal notice deposits, which are not included in M1, and into nonpersonal demand deposits, which are included, again distorted the aggregate's growth. Previous work at the C.D. Howe Institute (Boessenkool, Laidler, and Robson 1997) deals with this problem by adding nonpersonal chequable notice deposits to M1, thereby creating a new aggregate called M1X.

It should be possible to get a cleaner definition of transactions money by allowing for all these effects. We remove free credit balances and deposits of other financial institutions from M1 on the grounds that they are not transactions money, and we add nonpersonal chequable notice deposits on the grounds that they are practically indistinguishable from their demand counterparts. We call the resulting new aggregate *adjusted M1X* (M1AX). Figure 2 compares the inflation-adjusted stock of M1 with similarly adjusted stocks of M1A and M1AX since the late 1960s. Figure 3 shows growth of M1AX and of GDP; both the removal of free credit balances and financial-institution deposits and the "internalization" of the shift between notice and demand deposits improve the correlation between growth in the money supply and GDP growth.[7]

The removal of free credit balances and financial-institution deposits and the "internalization" of the shift between notice and demand deposits improve the correlation between growth in the money supply and GDP growth.

Estimating M1 Demand

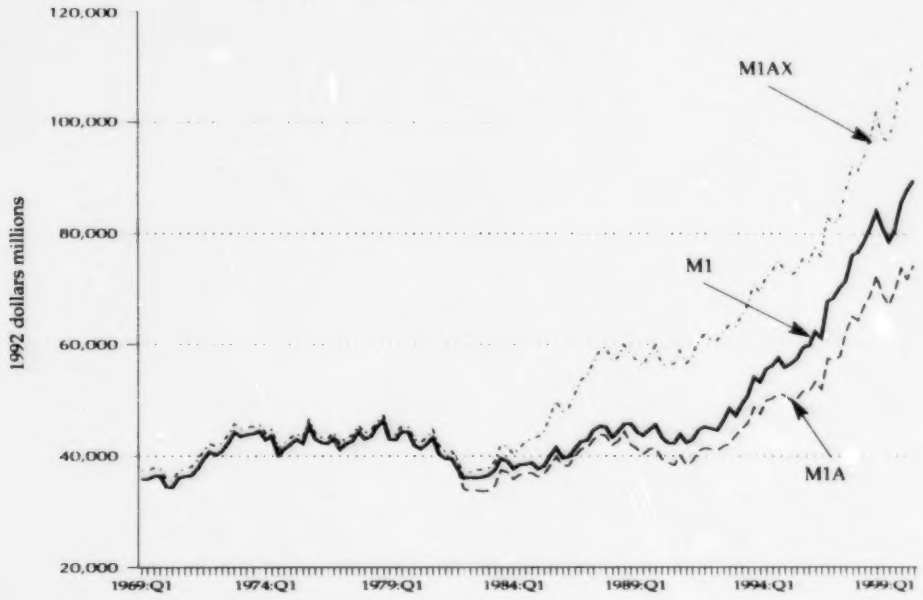
Having adjusted measured M1 to reduce the effects of institutional changes, we turn to trying to determine how much money Canadians would wish to hold if the economy

5 There is some oversimplification here, since financial institutions do transact in goods and services and maintain accounts connected with those transactions. Formally, however, measures of the money stock, such as M1, are measures of the liabilities of the banking *system* held by individuals and businesses outside it: accounts banks hold with each other are not counted. If the Bank of Canada consolidated the assets and liabilities of the financial institutions holding these accounts with the rest of the banking system, these accounts would not appear in the monetary aggregates.

6 Reserve requirements used to oblige banks to hold non-interest-bearing deposits at the Bank of Canada against certain types of deposits held by their customers. The required reserve ratio on notice deposits was lower than that required on demand deposits. By effectively taxing different types of deposits at different rates, this requirement created incentives for banks to classify deposits as notice rather than demand deposits and to move customers' money out of demand deposits and into notice deposits. With the phasing out of reserve requirements, these incentives disappeared, accelerating the growth of demand deposits at the expense of notice deposits.

7 From the first quarter of 1969 to the second quarter of 2000, the correlation coefficient between the growth of real M1 and the growth of real GDP two quarters later was 0.57, while the correlation coefficient between real M1AX and real GDP was 0.60. See the appendix for more information on these correlations.

Figure 2: *Real Stocks of M1, M1A, and M1AX, 1969:Q1–2000:Q2*



Sources: Statistics Canada, CANSIM; unpublished data from the Bank of Canada; and authors' calculations.

were growing at a rate consistent with stable inflation and interest rates were at levels consistent with that growth.

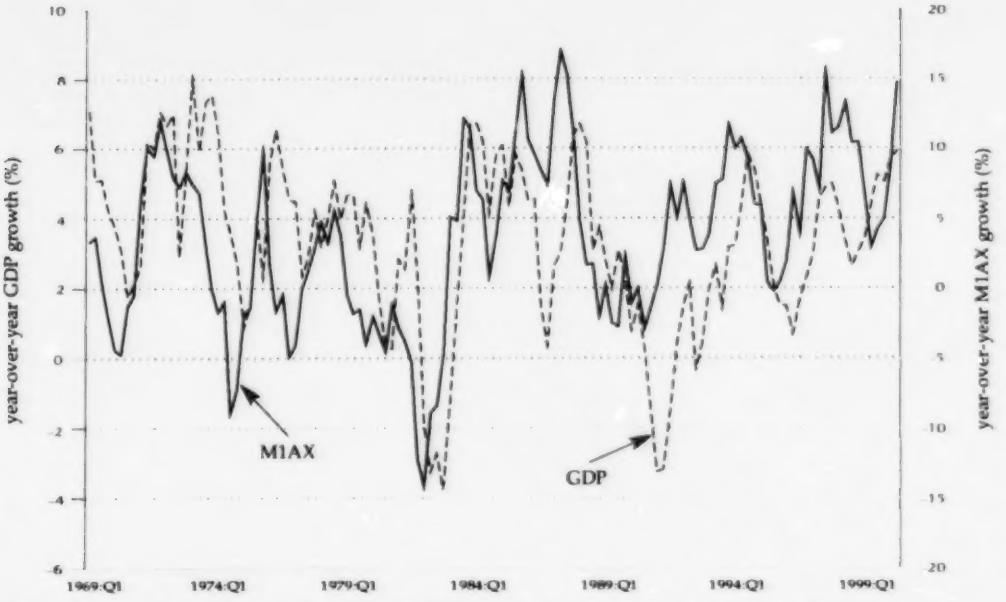
First, households' and firms' holdings of cash and chequing accounts balances ought to bear some relationship to their transactions in goods and services. A convenient measure of transactions is GDP. It is imperfect because it does not include purchases and sales of intermediate inputs, but as long as the ratio of intermediate sales to final sales in the economy is stable or follows a stable trend, this defect should not matter. GDP is also imperfect because it contains "imputed" items that do not require money, the most important being imputed rent — an estimate of what homeowners would have paid if they rented their residences. This problem is easy to address: to get a measure more closely related to money demand, we subtract imputed rent from GDP, which results in a construct we call *transactions GDP*, or GDPT.

Since the general price level affects the amount of money required for transactions, a further straightforward step is to adjust both the measure of transactions (GDPT) and the measure of the stock by the relevant price index (in this case, the implicit price deflator for GDPT).[8]

Another key influence on money demand is the difference between the rate of return paid on money balances and the rate of return available on liquid financial assets that are close substitutes for money. The greater the difference, the more expensive it is to hold transactions money and the more willing people are to forego its convenience. Cash pays no interest and for many years most other components of M1

8 Economic theory suggests that the demand for money should respond one-for-one to changes in the price level, a prediction supported by empirical work (Armour et al. 1996, 5).

Figure 3: *Real Growth Rates of GDP and M1AX, 1969:Q1–2000:Q2*



Sources: Statistics Canada, CANSIM; unpublished data from the Bank of Canada; and authors' calculations.

paid little or no interest, so the opportunity cost of holding M1 was essentially equal to the rate of return on alternatives, such as short-term securities or guaranteed investment certificates. More recently, however, thanks to advances in technology and competition among financial service providers, more of the deposits included in M1 pay interest. We estimate the average interest rate on M1AX from data on flows of funds. The difference between this interest rate and a liquid alternative — for which we use the rate on three-month Treasury bills (T-bills) — represents the opportunity cost of M1AX that we use in our statistical work.

Finally, since we are concerned about the recent behavior of M1AX — specifically, the possibility that the stock of money in circulation may be deviating from the amount that Canadians wish to hold for a given level of transactions and interest rates — we want to exclude the recent rapid growth from the period that we examine for clues about money demand. Accordingly, we exclude from our regression analysis observations after the fourth quarter of 1997. That point seems a reasonable cutoff: the economy was then growing steadily; inflation during the following year was roughly stable; and no financial shocks were affecting Canadian interest rates.

A regression of inflation-adjusted M1AX on inflation-adjusted GDPT (both measured in natural logarithms) and its opportunity cost, OC, yields the following equation. Standard errors are shown in parentheses below the relevant coefficients.[9]

9 We use data without seasonal adjustment, and therefore include quarterly dummy variables. The coefficients are robust to the inclusion of linear and quadratic time trends; augmented Dickey-Fuller tests suggest that the residuals are stationary despite the low Durbin-Watson statistic. A more complete set of diagnostic statistics for this and other similar regressions is contained in the appendix.

$$M1AX = -9.274 - 0.037Q2 - 0.128Q3 - 0.085Q4 + 1.710GDPT - 0.022OC.$$
$$(0.512)\quad (0.010)\quad (0.010)\quad (0.010)\quad (0.042)\quad (0.002)$$

$R^2 = 0.986$ SE = 0.027 DW = 1.19 Time period covered: 1983:Q1–1997:Q4

An odd feature of this equation is the high coefficient on GDTP. Much past empirical work on M1 tends to find a responsiveness to income growth of less than 1.0, a finding predicted by theoretical work on transactions money. In view of the fact that coefficients of about 1.7 result from several different specifications, however, we feel obliged to treat the finding seriously as a description of M1AX's historical behavior.[10]

Is Current M1 Growth Inflationary?

The final major step in our examination of money growth is to use these estimates of the responsiveness of money demand to income and interest rates to try to determine whether recent money growth threatens higher inflation. We do this by selecting a benchmark period in the past when economic conditions appear to have been consistent with stable inflation, and estimating a likely path for money demand growth since then. If M1AX appears to be above, or heading above, the upper bound of that estimated path, the Bank of Canada should consider tightening.

If M1AX appears to be above, or heading above, the likely path for money demand growth, the Bank of Canada should consider tightening.

Estimates of Noninflationary Money Growth

As noted above, the fourth quarter of 1997 seems a reasonable period to use as a benchmark. Twelve to 18 months after that date, key measures of prices registered increases similar to those they showed then (Bank of Canada 2000, 6–7), suggesting that, while the economy may not have been operating at its productive capacity, it was probably not very far below it.[11] Moreover, real GDP growth during the 12-month period following the fourth quarter of 1997 was 2.8 percent — about the middle of the range of estimates of growth in the economy's productive capacity[12] — evidence that monetary conditions at the end of 1997 were conducive to stable inflation growth. We therefore choose that period as an apt point for a benchmark from which to estimate how much demand for M1 would have grown in a stable environment where growth continued at a pace consistent with steady inflation.

Of the factors influencing demand, increases in the price level are the most straightforward to deal with. Since the Bank of Canada's target for inflation is a forward-looking one in which past under- or overshoots are ignored, we simply use the

10 Anticipating later discussion, we emphasize that if this coefficient is an overestimate, calculations of M1AX demand using it will tend to be exaggerated, *understating* the inflationary pressures inherent in any given level of the actual money stock.

11 The Bank of Canada estimates that the difference between actual and potential output in the fourth quarter of 1997 was a disinflationary gap of about 1.5 percentage points (Bank of Canada 2000, 14). There is, however, considerable uncertainty about such estimates — the 95 percent confidence interval around them is about 2 percentage points either way — and the stability of inflation during the following period suggests the gap was small. The latest estimate by the Organisation for Economic Co-operation and Development of Canada's output gap during all of 1997 was 1.1 percent (OECD 2000, 255).

12 The Bank of Canada's estimate of the output gap in the fourth quarter of 1998 was virtually unchanged from its estimate in the fourth quarter of 1997 (Bank of Canada 2000, 14).

increases in the deflator for GDPT that actually occurred between the fourth quarter of 1997 and the second quarter of 2000.

The influence of GDPT growth is trickier to estimate for two reasons. There is disagreement about how quickly the economy's productive capacity is growing and, therefore, about how quickly spending can grow without producing inflationary or disinflationary output gaps. Also, as the standard errors in our equation indicate, estimates of the responsiveness of money demand to growth in expenditures and incomes are imprecise. We therefore produce both a low- and a high-growth estimate of the response of money demand to increases in potential output. The low-growth estimate assumes that capacity has been growing at an annual rate of 2.5 percent and that the responsiveness of demand to that growth is at the lower end of the likely range of our estimate (two standard errors below the estimate). The high-growth estimate assumes that capacity has been growing at an annual rate of 3 percent and that the responsiveness of demand is at the higher end of our range (two standard errors above the estimate).

Next is the question of what to assume about interest rates and how they affect money demand. Again, we allow for uncertainty on this issue using a double-barreled approach. Our low-growth estimate assumes that the increase in the opportunity cost of holding transactions money between the fourth quarter of 1997 and the second quarter of 2000 — an increase of 192 basis points — is consistent with noninflationary growth and that the depressive effect of those increases on money demand is at the upper end of (two standard errors above) a range around our estimate of this effect. Our high-growth estimate assumes that the level of interest rates in the fourth quarter of 1997 was consistent with stable inflation growth both then and now and allows for no such depressive effect.

Finally, we adjust our starting points. Our benchmark for the money stock is not quite the same as the amount outstanding in the fourth quarter of 1997, for two reasons. First, the value we estimate in our money demand equation is below the actual figure for M1AX at that time. Our second adjustment moves our benchmark in the opposite direction and largely offsets the first change. Most observers feel that actual output was then below potential, so we raise our benchmark from where it would otherwise have been to allow for the money growth that would merely have accommodated a return to stable-inflation output. Finally, acknowledging the uncertainty about our estimates, we begin our low- and high-growth paths at points a little more than 5 percent lower and 5 percent higher (two standard errors in our regression) than our adjusted benchmark.

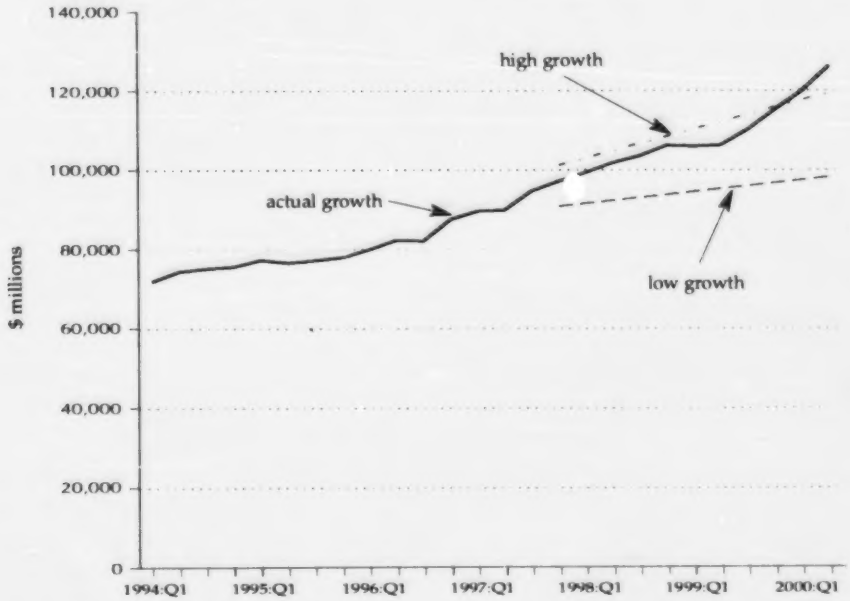
We calculate the likely change in demand for M1AX between the fourth quarter of 1997 and the second quarter of 2000.

Then, using the above estimates for the responsiveness of money demand to output growth and interest rates, we calculate the likely change in demand for M1AX between the fourth quarter of 1997 and the second quarter of 2000. Figure 4 traces the resulting growth-path estimates, along with the actual growth of M1AX.[13] (Box 2 explains all these calculations in greater detail.)

The movement of M1AX relative to our estimated target range has some interesting features. We note, though the uncertainties in interpreting short-term movements in the monetary aggregates lead us not to put much weight on it, that M1AX's temporary dip in 1999 suggests slackening growth in mid-2000, for which the second quarter national

13 The M1AX series shown in the figure was adjusted for seasonality using the moving-average method.

Figure 4: ***Target Bands for M1AX and Actual M1AX, 1994:Q1–2000:Q2***
(seasonally adjusted)



Sources: Statistics Canada, CANSIM; unpublished data from the Bank of Canada; and authors' calculations.

accounts and recent weaker employment figures provide some evidence. The usual lags mean that this pause may precede a slackening of price pressure around the end of 2000. The more rapid money growth in early 2000 would normally signal renewed economic vigor later in the year, with inflationary pressure mounting in 2001.

Most important, these estimates suggest that even if the demand for money is at the highest levels indicated by our analysis, recent M1AX growth has still been unsettlingly strong. Rather than simply raising the level of money back to where it ought to have been after weakness in 1999, the robust expansion of early 2000 may threaten a resurgence of inflation.

Caveats and Other Evidence

Despite the past forecasting records of M1 and M1AX and the reasonable story behind their significance as leading indicators of output and inflation, there are inevitable doubts about their reliability as a signal of the current outlook. Some of the recent growth in these aggregates could reflect further changes in the financial industry whose details are not yet clear (such as growth in multipurpose accounts that are counted in M1 yet are predominantly saving accounts). On the whole, however, we are inclined to see the weight of evidence as supporting concern about recent rates of money growth.

Our methodology has offset at least some of the uncertainties inherent in statistical work. Our use of two standard errors in setting our benchmarks and in estimating our elasticities is a fairly generous accommodation, as is our combining of *all* factors that would contribute to high demand in our high-growth estimate. To see money growth

Box 2: *Calculating the Money Target*

Judging how much M1AX would be consistent with stable-inflation growth requires first finding a benchmark point and then estimating how the demand for M1AX is likely to have grown since then.

We selected the fourth quarter of 1997 as a benchmark for reasons discussed in the text. Our point estimate (the fitted value in our regression) of money demand at that time is some 3 percent below the actual level of M1AX. Because the economy was likely operating below capacity in the fourth quarter of 1997, however, we raise the benchmark point a bit: by roughly 1.7 percentage points — an output gap of 1 percent multiplied by our estimate (1.7) of the responsiveness of M1AX demand to changes in GDPT (GDP less imputed rent:). Because there is uncertainty about this estimate, the starting points we use for our high- and low-growth paths for M1AX demand are some 5.4 percent above and below it (5.4 percent is equal to two standard errors of the estimate of our regression, which means we have 95 percent confidence that the true value of M1AX demand falls within this range).

Next, we need estimates of how much demand for M1AX has grown since then due to changes in output and in the opportunity cost of holding M1AX. Our regression results provide us with estimates of these responses. Since both M1AX and GDPT are expressed in natural logarithms, the elasticity of M1AX demand with respect to GDPT is simply the coefficient on GDPT. Since the opportunity cost is expressed in percentage points, the elasticity of M1AX demand with respect to changes in it is the coefficient on opportunity cost multiplied by its level, for which we use the average of the figures in the fourth quarter of 1997 and the second quarter of 2000. For both elasticities, we add or subtract two standard errors from the coefficients in our regression in calculating the high- and low-growth paths. (As already noted, we assume that the elasticity of M1AX demand with respect to the price level is unity.) This method greatly increases our confidence that M1AX demand lies within the area bounded by our high- and low-growth paths.

The table in this box shows the steps in calculating the target range. The end points of the high- and low-growth paths are derived by multiplying the starting points by the total percentage change in estimated M1AX demand, taking into account the elasticities and the changes in potential output, in opportunity cost, and in the price level between the fourth quarter of 1997 and the second quarter of 2000. The growth paths are interpolated between the starting and end points.

Calculation of the Target Range for Money Demand

	Low Growth	High Growth
Starting value *($ millions)*	95,926	95,926
Starting value +/– 2 standard deviations *($ millions)*	90,748	101,104
Change in potential GDPT, 1997:4Q–2000:2Q *(%)*	6.37	7.67
Income elasticity	1.63	1.79
Demand change due to income change *(%)*	10.36	13.77
Change in OC, 1997:4Q– 2000:2Q *(%)*	68.25	0
OC elasticity	–0.095	–0.068
Demand change due to OC change *(%)*	–6.51	0
Price level elasticity	1	1
Change in price level *(%)*	3.34	3.34
Total change *(%)*	7.19	17.11
Estimated demand in 2000:2Q *($ millions)*	97,272	118,398

Source: Authors' calculations.

shooting through the top of a range that is deliberately constructed to be quite wide increases our confidence that we are seeing something significant.

Another aspect of this analysis that heightens our concern is the high sensitivity we estimate for the responsiveness of money demand to growth in potential output. Most analysts would have expected considerably something lower than the 1.7 figure we obtained. A figure of unity or less, however, would suggest that demand for M1AX is lower than we estimate, making the actual stock now in circulation more alarming.

Further supporting our concern is the fact that the growth in broader monetary aggregates has accelerated. M2 rose at an annual rate of 7.7 percent from January to July 2000, M3 at an annual rate of 8.6 percent over the same period, and M2++ — the Bank of Canada's favored leading indicator of inflation — at an annual rate of 8.7 percent over the six months ending in June. These accelerations suggest that the growth in the narrow aggregates is not simply the result of deposits shifting into M1 accounts from accounts measured only in the broader aggregates. Rather, the growth of the broader aggregates themselves has been faster than the Bank has typically viewed as consistent with its inflation target (Bank of Canada 2000, 26–27).

We also note that the foreign exchange value of the Canadian dollar remains low despite a strong economy and inflation that is persistently lower in Canada than in the United States. One possible explanation of the dollar's low price is that too many of them are in circulation for the market to support a higher one.

Recent inflation numbers are less reassuring than the 1.5 percent increases in the CPI's core components — prices excluding food and energy — may suggest.

Finally, recent inflation numbers are less reassuring than the 1.5 percent increases in the CPI's core components — prices excluding food and energy — may suggest. Over short periods of time, excluding relatively volatile food and energy prices to get a clearer picture of inflationary trends makes sense, but if overall inflation is to stay on target over longer periods, persistent rises in *any* component of the CPI need to be offset by persistent declines in others. Since the beginning of 2000, however, energy-induced increases in total CPI inflation have been accompanied by increases in nonenergy price inflation as well, suggesting that monetary policy is permitting faster rises in all prices.

The Answer: The Bank Should Slow the Press

To sum up, our analysis suggests that the printing press is running too fast. If the Bank of Canada does not act to slow M1 growth, an acceleration of economic growth past the point that is consistent with stable inflation looks likely.

We acknowledge that special factors may be affecting measured M1. Further research at the Bank of Canada and the financial institutions that hold transactions deposits might make it possible to speak with more confidence about the factors behind recent M1 growth. Our methods, however, make generous allowance for all the factors of which we are aware and still suggest that M1 is growing too fast.

We conclude, therefore, that increases in the overnight rate to date have not been enough to slow Canadian money growth to an a pace consistent with 2 percent inflation. If M1 growth does not soon fall below double digits, the Bank of Canada will need to hike short-term interest rates further in the fall to slow the press and keep inflation on target.

Appendix: Statistical and Econometric Evidence

Estimating money demand equations is always a challenge. Even if the relationships between that demand and the variables generally assumed to influence it — output, prices, and interest rates — are stable, financial sector innovations can produce their own fluctuations in the money stock.

Choosing the Appropriate Monetary Aggregate

In regression analysis, the two most common ways of dealing with such changes are the use of dummy variables and the construction of new aggregates that attempt to remove their effects.

Adding dummy variables to a regression is problematic. Coefficients on dummy variables often capture other effects as well and, in the process, contaminate estimates of the impact of those other effects. Instead, we chose to construct a new aggregate, M1AX. As described in the text, we subtracted free credit balances and deposits of other financial institutions from M1 because these amounts do not appear to represent transactions money in the hands of the nonbank public, and we added nonpersonal chequable notice accounts because the distinction between them and current accounts is unclear.

The theory behind the construction of M1AX sounds reasonable, but is it supported by the data? Table A-1, which shows correlations between growth in inflation-adjusted money and GDP is encouraging. Since it takes time until the effects of changes in the monetary aggregates on GDP appear, we show the correlation between the current growth, *t*, of the money aggregates and the growth of GDP one, two, and three quarters ahead. The new monetary aggregate, M1AX, has a greater correlation in every time period. In this sense, its predictive power can be said to be better than M1's.

The Relationship between Money Demand, GDP, and the Opportunity Cost

To estimate the demand for money, we used ordinary least-squares regression and, as explanatory variables, real GDPT and the opportunity cost, OC, of holding M1AX (which can best be measured, given available data, by the three-month T-bill rate minus the ratio to M1AX of interest paid on deposits included in M1AX). To avoid moving-average problems, we used data without seasonal adjustment and added seasonal dummy variables to the regression. We adjusted our money series for inflation by dividing it by the implicit price deflator for GDPT. The results of this regression are shown in Table A-2, where M1AX and GDPT are expressed in natural logarithms.

Past research at the Bank of Canada (for example, Armour et al. 1996) tends to find that the presence of a unit root in M1 and in our explanatory variables cannot be rejected; the augmented Dicky-Fuller test computed to three lags on the residuals in this regression suggests that they are stationary and that a long-run cointegrating relationship exists (the critical values for the test are –1.947 for a 5 percent probability of a unit root and –2.606 for a 1 percent probability). As we show below, the results are robust to the inclusion of time trends in the regression, increasing our confidence in the reliability of these coefficients.

Other Specifications and Monetary Aggregates

The high coefficient on GDPT led us to try several other alternative specifications, the results of which are shown in Table A-3. None of them is obviously superior to our favored regression. Regressions using M1A obtain lower coefficients on income. However, they exhibit worse autocorrelation in the residuals (as shown by the lower Durbin-Watson statistic), and augmented Dicky-Fuller tests on the specification matching our favored regression suggest nonstationary residuals, casting doubt on the reliablity of these coefficients for policy.

We also ran our regressions using alternate money aggregates and time periods. The results (shown in Table A-4) do not change our main conclusion: that recent money growth suggests future inflation. Indeed, the other aggregates, which have lower elasticities with respect to output, support stable inflation growth rates lower than those we report for M1AX.

Table A-1: ***Correlations between Year-Over-Year Growth in Real GDP, M1, and M1AX, 1969:Q1–2000:Q2***

	GDPt	GDPt+1	GDPt+2	GDPt+3
M1	0.3113	0.4864	0.5744	0.5214
M1AX	0.3584	0.5256	0.5996	0.5383

Source: Statistics Canada, CANSIM; unpublished Bank of Canada data; and authors' calculations.

Table A-2: ***Regression Results, Dependent Variable: M1AX, 1983:Q1–1997:Q4***

Variable	Coefficient	Standard Error	t-value	t-probability	Partial R^2
Constant	-9.274	0.512	-18.095	0.0000	0.858
OC of M1AX	-0.022	0.002	-12.075	0.0000	0.730
GDPT	1.710	0.042	40.446	0.0000	0.968
Q2, dummy	-0.037	0.010	-3.752	0.0004	0.207
Q3, dummy	-0.128	0.010	-12.391	0.0000	0.734
Q4, dummy	-0.085	0.010	-8.328	0.0000	0.562
R^2 = 0.986	Durbin Watson = 1.19		Augmented Dicky-Fuller on three lags residuals: -3.0953 (significant at the 1% level)		

Sources: Statistics Canada, CANSIM; and authors' estimates.

Table A-3: ***Alternative Models for Money Demand, 1983:Q1–2000:Q1***

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7, 1983:Q1–1997:Q4	Model 8, 1983:Q1–1997:Q4
				Dependent Variable: M1A				
Constant	-3.811	0.428	-11.091	-0.897	-8.140	-2.449	-0.267	0.610
t-value	-3.578	1.008	-3.373	-0.691	-4.790	-1.931	-0.291	1.396
OC of M1A	-0.025	-0.007	-0.033	-0.009	-0.019	-0.011	-0.024	-0.008
t-value	-5.904	-4.291	-6.080	-3.856	-6.421	-4.810	-7.829	-4.495
GDPT	1.231	0.035	1.859	0.160	1.606	0.494	0.932	0.073
t-value	14.085	0.537	6.583	1.206	11.007	3.208	12.291	1.012
Q2, dummy	-0.032	0.025	-0.045	0.022	-0.030	0.011	-0.018	0.022
t-value	-1.377	2.913	-1.941	2.442	-2.488	1.187	-0.960	2.412
Q3, dummy	-0.091	0.036	-0.142	0.026	-0.108	-0.004	-0.062	0.029
t-value	-3.795	3.483	-4.462	1.809	-6.534	-0.278	-3.197	2.586
Q4, dummy	-0.061	0.034	-0.103	0.026	-0.069	0.005	-0.037	0.026
t-value	-2.568	3.583	-3.528	2.071	-4.576	0.383	-1.932	2.535
$M1A_{t-1}$		0.925		0.913		0.690		0.866
t-value		21.140		20.203		9.164		13.776
time			-0.005	-0.001	-0.014	-0.005		
t-value			-2.331	-1.081	-10.859	-3.591		
$time^2$					0.000	0.000		
t-value					13.240	3.538		
Long-run GDPT		0.460		1.829		1.594		0.543
Long-run OC		-0.097		-0.103		-0.034		-0.063
R^2	0.901	0.988	0.909	0.988	0.977	0.990	0.894	0.977
Durbin-Watson	0.214	2.490	0.355	2.450	0.872	2.230	0.371	2.520
Standard error	0.069	0.024	0.067	0.024	0.034	0.022	0.051	0.024
				Dependent Variable: M1AX				
Constant	-10.446	-2.073	-9.103	-2.790	-8.814	-3.021	-9.274	-2.666
t-value	-20.435	-2.480	-5.834	-2.536	-6.049	-2.852	-18.095	-3.141
OC of M1AX	-0.021	-0.009	-0.019	-0.010	-0.017	-0.010	-0.022	-0.011
t-value	-10.205	-5.405	-6.693	-5.189	-6.285	-5.160	-12.075	-6.463
GDPT	1.809	0.419	1.693	0.466	1.669	0.526	1.710	0.565
t-value	43.198	3.180	12.625	3.332	13.327	3.864	40.446	4.100
Q2, dummy	-0.043	0.014	-0.040	0.013	-0.037	0.011	-0.037	0.009
t-value	-3.992	1.672	-3.576	1.590	-3.553	1.432	-3.752	1.008
Q3, dummy	-0.133	0.005	-0.123	0.001	-0.118	-0.004	-0.128	-0.012
t-value	-12.166	0.336	-7.878	0.074	-8.047	-0.256	-12.391	-0.794
Q4, dummy	-0.091	0.013	-0.083	0.009	-0.077	0.006	-0.085	-0.001
t-value	-8.322	1.094	-5.602	0.744	-5.553	0.550	-8.328	-0.094
$M1AX_{t-1}$		0.739		0.755		0.711		0.635
t-value		10.754		10.692		10.143		8.483
time			0.001	-0.001	-0.001	-0.002		
t-value			0.911	-1.003	-0.962	-2.193		
$time^2$					0.000	0.000		
t-value					3.220	2.511		
Long-run GDPT		1.602		1.903		1.818		1.548
Long-run OC		-0.035		-0.041		-0.033		-0.030
R^2	0.987	0.995	0.987	0.996	0.989	0.996	0.986	0.994
Durbin-Watson	0.935	1.890	0.846	1.950	0.931	2.030	1.190	2.030
Standard error	0.032	0.019	0.032	0.019	0.030	0.018	0.027	0.018

Note: M1A, M1AX, and GDPT are in 1992 dollars, expressed in natural logarithms; opportunity cost is expressed in levels. Data are not adjusted for seasonality.

Sources: Statistics Canada, CANSIM; and authors' estimates.

Table A-4: ***Regression Results Using Other Aggregates and Annual Data, 1983:Q1–1997:Q4***

	Gross M1A	Gross M1AX	Annual Data, M1A	Annual Data, M1AX
Constant	1.908	–7.548	–1.161	–11.545
t-value	1.900	–14.139	–0.581	–13.600
Opportunity cost	–0.023	–0.021	–0.027	–0.023
t-value	–6.885	–11.358	–4.287	–8.420
GDPT	0.747	1.564	0.901	1.699
t-value	9.001	35.520	6.100	27.119
Q2, dummy	–0.012	–0.033		
t-value	–0.596	–3.274		
Q3, dummy	–0.044	–0.115		
t-value	–2.072	–10.871		
Q4, dummy	–0.021	–0.075		
t-value	–1.022	–7.115		
R2	0.841	0.983	0.913	0.994
Durbin-Watson	0.258	1.050	0.708	1.890
Standard error	0.056	0.028	0.048	0.019

Source: Authors' calculations.

References

Armour, Jamie, et al. 1996. "A Distant-Early-Warning Model of Inflation Based on M1 Disequilibria." Bank of Canada Working Paper 96-5. Ottawa.

Aubry, Jean-Pierre, and Loretta Nott. 2000. "Measuring Transactions Money in a World of Financial Innovation." In *Money, Monetary Policy, and Transmission Mechanisms*, 3-35. Proceedings of a conference held by the Bank of Canada, November 1999. Ottawa: Bank of Canada.

Bank of Canada. 2000. *Monetary Policy Report*. Ottawa. May.

Boessenkool, Kenneth J., David E.W. Laidler, and William B.P. Robson. 1997. "More Money Than Is Good for Us: Why the Bank of Canada Should Tighten Monetary Policy." *C.D. Howe Institute Commentary* 95. Toronto: C.D. Howe Institute. July.

Laidler, David E.W., and William B.P. Robson. 1994. *The Great Canadian Disinflation: The Economics and Politics of Monetary Policy in Canada, 1988–93*. Policy Study 19. Toronto: C.D. Howe Institute.

Organisation for Economic Co-operation and Development (OECD). 2000. *OECD Economic Outlook*. Paris. June.